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REGENERATIVE CAPACITY OF MOTOR MUSCLES OF ANIMALS

/Digest/

It has been assumed, hitherto, that striated muscle tissue of animals lacks any regenerative capacity whatever and that healing of injured tissue of this kind proceeds by virtue of the formation of scar connective tissue only. The matter was recently submitted to renewed experimental investigation by workers at the Histological Laboratory of the Institute of Animal Morphology imeni A. N. Severtsov of the Academy of Sciences USSR. The work in question was carried out under the direction of Studitskiy, Doctor of Biological Sciences. Careful experiments have shown that striated muscle tissue of all vertebrates, including birds and mammals, is capable of regeneration.

Experiments were carried out on cockerels, rats, guinea pigs, rabbits, and dogs. In the case of adult rats (age 6-8 months), the peritoneum was opened under ether narcosis and the right cupola of the diaphragm exposed. Then the diaphragm was injured by making openings in it, the openings having an average diameter of 2-3 mm and not exceeding 4 mm. The injuries were made in spots between the large blood vessels and branches of the nerve network. Injuries up to 0.5 cm in diameter were also made on other muscles. The results of dissection were as follows:

A dissection on the fifth day after the operation showed that the edges of injured parts of the diaphragm had grown firmly onto the adjacent section of the liver. The liver could still be clearly seen from the pectoral side through the openings. From the 8th to the 14th day after the operation, dissections revealed a gradual filling out of the injury with newly formed tissue. In the beginning, a thin transparent film formed. At about the 20th day, this film was much thicker and filled out completely the vacant space which had been produced by inflicting the injury. At the expiration of 32 days, a solid lump of regenerated tissue was apparent on the pectoral side. On the peritoneal side this lump was usually fused with the capsule of the liver. The regenerated tissue was in the same state 45 days after the operation.

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Microscopic study showed a distinct picture of the regeneration of differentiated muscle fibers in the newly formed tissue. The regeneration process began with the formation of typical regenerative buds at the tips of the injured muscle fibers. These buds represent accumulations of sarcoplasm in which myofibrils gradually disappear and an increasing quantity of nuclei form. Thereupon individual myoblasts, which also participate in the regeneration of muscle tissue, are released. Similar results were obtained in experiments carried out on other muscles.

The results of the microscopic investigation leave no doubt that injured rat muscle tissue actually regenerates when it is in a state of tension, notwithstanding the fact that there is considerable development of scar connective tissue. Being disposed in the direction of the tensile force, the fibers of connective tissue do not prevent growth and differentiation of the regenerating muscle tissue.

On the basis of these experiments and experiments carried out on other mammals and birds, one must conclude that absence of muscle regeneration in mammals is not due to the lack of any inherent capacity to regenerate striated muscle tissue, but to the fact that favorable conditions for that type of regeneration are generally absent. Tension plays an essential role among the favorable conditions which must be present for regeneration to take place. At present, the conditions which expedite or prevent muscle regeneration are being studied in detail.

The work in question is not merely of theoretical interest; for practical surgery will be advanced when it can utilize the results of this investigation.

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